

AGS Studies Report

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 Subject Transition Jump Using  $\Delta v$  Produced by the Polarized  
Proton Fast Quadrupoles

Observations and Conclusion

This method was successfully used at CERN many years ago at a level of a few  $10^{12}$  protons. They produced a  $(\Delta v_H)_{TR} \approx 0.2$  with about a 1-2 msec rise time. Since  $\Delta v_H \approx \Delta \gamma$ , this gave them a  $(\Delta \gamma)_{TR}$  of 200/sec, an enhancement factor of 7, and allowed a clean jump at about  $2-3 \times 10^{12}$ .

The polarized proton fast quads are capable of producing a  $\Delta v_H \approx 0.2$  in 2  $\mu\text{sec}$  or a  $\Delta \gamma \approx 10^5/\text{sec}$ , an enhancement of 2000. However, it is not only rate that is necessary, but one must not destroy the beam by this non-adiabatic pulse.

In order to produce a  $\Delta v_H \approx 0.2$ , since the quads are located at vertical  $\beta$ -max positions, one has to apply a  $\Delta v_V \approx 0.4$ . This would drive the tune to cross  $v_V = 9$  and so to prevent this, one must also energize the slow quads to compensate for this.

As we set up conditions for making these tests, it appeared that 2  $\mu\text{sec}$  was too fast. We therefore turned off the HV 2  $\mu\text{sec}$  pulse and used only the LV 50  $\mu\text{sec}$  pulse from the fast quad modulators. This rise time factor will be reinvestigated in our next study. We used the vertical slow quads to compensate for the fast quad pulse and measured that our  $(\Delta v_H)_{TR} = -0.17 \pm 0.01$  with about a 50  $\mu\text{sec}$  rise time. This gives an enhancement of 68 which would be good for  $2 \times 10^{13}$  protons, but one must not only have crossing speed but also we think significantly higher  $\Delta \gamma$ . We were operating the AGS at this time with  $2 \times 10^{12}$  circulating protons and we were able to cross transition very smoothly with this technique. Our attempt to increase the intensity

was masked by other problems and finally lack of time. It is not clear what the intensity limit of this method is and we will plan to continue this study during the next AGS operating period. The following pictures on Page 5 of the  $\gamma_{TR}$  Studies Book show the effect at transition produced by the fast tune shift. A much smoother passage is produced using the fast quads.

Measured with 9 Mods

	Base	Slow Q	Fast Q
Q <sub>V</sub>	8.780	- .20 = 8.580	+ .30 = 8.88
$\times \frac{10}{9}$		- .22 = 8.560	+ .33 = <u>8.89</u>
Q <sub>H</sub>	8.713	+ .10 = 8.813	- .16 = 8.66
		+ .11 = 8.823	- .18 = <u>8.64</u>
		$\pm .01$	$\pm .01$

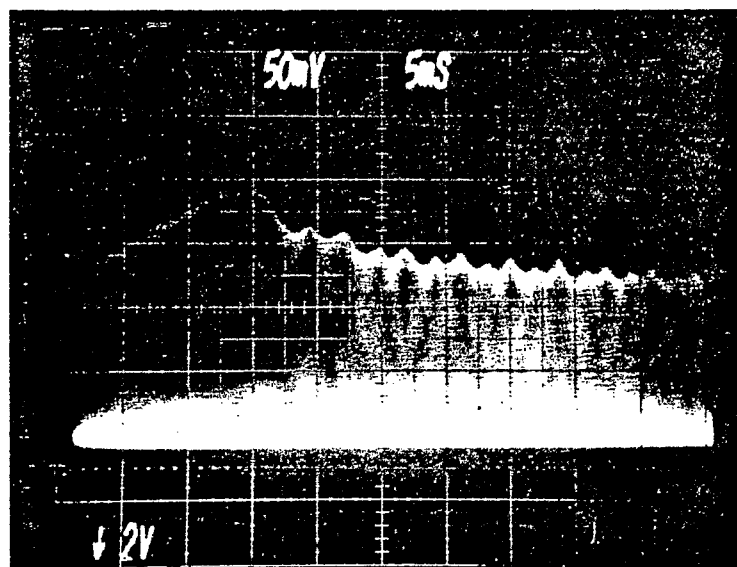
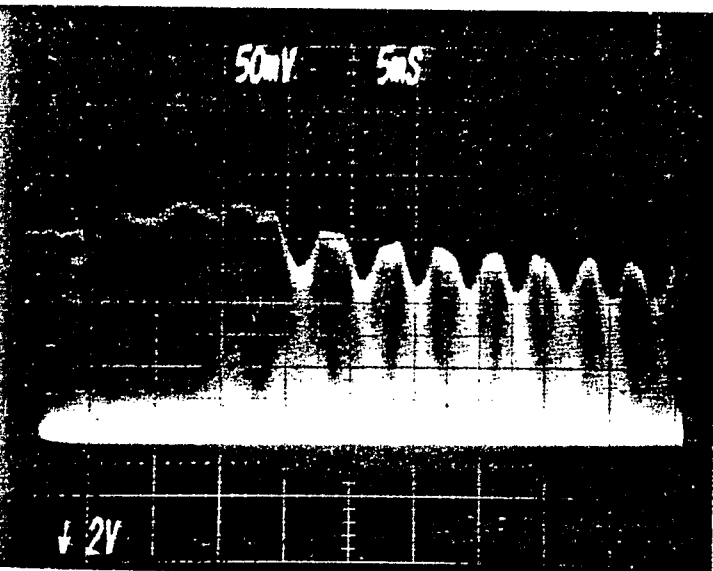
$$(\Delta V_H)_{\text{fast}} = -.17 \pm .01 \approx (\Delta \delta)$$

$$\Delta t = 50 \times 10^{-6} \text{ sec}$$

$$\frac{\Delta V}{\Delta t} = \frac{.17 \times 10^6}{50} = 3.4 \times 10^3$$

$$\left(\frac{\Delta \delta}{\Delta t}\right)_0 = \frac{30}{.6 \text{ sec}} = 50/\text{sec}$$

$$\rightarrow f = 68$$



FAST Q OFF. TIMING OF  
 $\phi$  JUMP OPTIMIZED. NO  
 RADIAL SHIFT.

Q<sub>2</sub> 10<sup>12</sup>

FAST Q ON. TIMING OPTIMIZED  
 NO RADIAL SHIFT  
 $\phi$  JUMP @ 15650  
 FQ @ 15800